COURSE OUTLINE

(1) GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	DEPARTMENT OF PHYSICS		
LEVEL OF STUDIES	POSTGRADUATE		
COURSE CODE	**M143**	**SEMESTER**	**2**
COURSE TITLE	MATERIALS SCIENCE		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
	4	7
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special background, specialized general knowledge, skills development
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	

(2) LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The course provides the students with specialized and deeper knowledge concerning the structure and physical properties of modern and technologically important natural, synthetic and composite materials focusing on their solid state.

In particular after the successful completion of the course the students will be in position to:

- comprehend and correlate the atomic and electronic structure of solids, their chemical composition, atomic bonds and physical properties
- comprehend the atomic periodicity in solids, the crystal and amorphous structures of solids and know the basic methods for characterization and study of their atomic structure
- comprehend and describe the characteristics and properties of defects, secondary phases and doping, as well as atomic diffusion in solid state materials
- have a deeper comprehension and be able to interpret the phase diagrams

of the structural, physical, electric, magnetic and other relative states as a function of various physical quantities and parameters concerning solid materials, phase transitions and their kinetics in relation to their properties, as well as the characteristics and properties of the thermodynamically stable and metastable phases

- have knowledge of the characteristics and properties of the natural, mineral, synthetic and composite materials
- have knowledge of and be able to dissever the characteristics and properties of the bulk, nanostructured three-dimensional, two-dimensional, one- dimensional and quantum dot materials (3D, 2D, 1D and 0D), as well as of the nanostructured hybrid materials
- to deepen their knowledge, understanding, interpretation and correlation among the structural, electronic, thermal, magnetic, optical and mechanical properties of metallic materials and their alloys, ceramic materials and glasses and polymeric materials
- have knowledge of the characteristics and properties of materials for energy storage and conversion: materials for electrical-chemical energy storage, thermoelectric, magnetocaloric and optoelectronic materials
- have knowledge of the characteristics and properties of superconducting materials.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Production of new research ideas	*Others…*
	…….

Search for, analysis and synthesis of data and information, with the use of the necessary technology.
Working independently.
Working in an interdisciplinary environment.
Decision-making.
Production of free, creative and inductive thinking.

(3) SYLLABUS

Correlation of the atomic and electronic structure of solids, their chemical composition, their atomic bonds and their physical properties. Atomic periodicity in solids, crystal and amorphous structures of solids: overview, morphology, characterization and study of their atomic structure. Defects, secondary phases and doping of materials, as well as atomic diffusion in solid materials and the relation to their characteristics and properties. Deeper comprehension and interpretation of phase diagrams of the structural, physical, electric, magnetic and other relative states as a function of various physical quantities and parameters concerning solid

materials. Phase transitions and their kinetics in relation to their properties. Characteristics and properties of the thermodynamically stable and metastable phases. Characteristics and properties of the natural, mineral, synthetic and composite materials. Characteristics and properties of the bulk, nanostructured three-dimensional, two-dimensional, one- dimensional and quantum dot materials (3D, 2D, 1D and 0D), as well as of the nanostructured hybrid materials. Thorough examination and understanding, interpretation and correlation among the structural, electronic, thermal, magnetic, optical and mechanical properties of metallic materials and their alloys, ceramic materials and glasses and polymeric materials. Characteristics and properties of materials for energy storage and conversion: materials for electrical-chemical energy storage, thermoelectrics, magnetocaloric and optoelectronic materials. Characteristics and properties of superconducting materials.

(4)

TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face teaching
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of ICT in teaching, use of electronic projectors in lectures. Direct communication with students on lectures and in laboratories. Additional usage of the Moodle asynchronous e-learning system.
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	

Activity	*Semester workload*
Lectures	39
Tutorials/Practice	13
Educational visits	6
Study and analysis of bibliography	34
Essay writing	45
Non-directed study	35
Exams	3
Course total	***175***

STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- "Materials Science and Engineering AN INTRODUCTION" 9th Edition, William

D. Callister, Jr. & David G. Rethwisch, Wiley 2014.

- "Fundamentals of Materials Science and Engineering: An Integrated Approach" 5th edition. W.D. Callister Jr και D.G. Rethwisch, Wiley 2015.
- "The Science and Engineering of Materials", Donald R. Askeland, Pradeep P. Fulay, Wendelin J. Wright, Cengage Learning 2010.
- "Essentials of Materials Science and Engineering" Second Edition, SI, Donald R. Askeland, Pradeep P. Fulay, D. K. Bhattacharya, Cengage Learning 2010.
- "Engineering Materials" Vol 1 and 2, Michael F. Ashby & David R. H. Jones Elsevier 2012-13.

- Related academic journals:

- Advanced Materials
- Nature Materials
- J. American Chemical Society
- ACS Nano
- Small
- Nanoscale
- Nature
- Science
- Advanced Functional Materials
- Physical Review B
- Progress in Materials Science
- Nature Physics
- Nature Nanotechnology
- Nano Letters
- Applied Physics Letters
- J. Applied Physics
- J. Physics: Condensed Matter
- J. Materials Chemistry
- Inorganic Chemistry
- Materials Today
- J. Nanoparticle Research
- Nano Today
- Proceedings of the National Academy of Sciences
- J. American Ceramic Society